

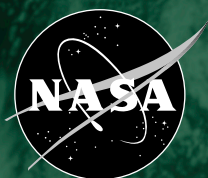
NASA Office of Aerospace Technology
Volume 8, Number 4 July/August 2000

Aerospace Technology INNOVATION

Live!
On a Computer Near You



Lightning Strike Location System Developed
Technology Finds Hidden Faults
NASA Develops Drill for the Future



Aerospace Technology INNOVATION

Volume 8, Number 4 July/August 2000

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About the Cover:

A partnership between NASA and Dreamtime Holdings, Inc. will allow the public to watch future space missions from launch to landing.

Online Edition: Go to <http://nctn.hq.nasa.gov> on the World Wide Web for current and past issues.

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COMMERCIAL DEVELOPMENT MISSION UPDATE

Date*	Flight	Payload	Sponsor/Coordinator
9/00	STS-106	Commercial Generic Bioprocessing Apparatus (CGBA)	Bioserve Space Technologies

* As of August 2000.
Key: STS—Space Transportation System

WELCOME TO INNOVATION

New Views for A New Century

By Peggy Wilhide

*Associate Administrator for Public Affairs
NASA Headquarters*

THIRTY YEARS AGO, NASA AND THE REST OF the world learned firsthand the power of the recorded image. The lesson came on Christmas Eve of 1968, at the end of a year that, until then, was known more for its upheaval, tragedy and turbulence than for its serene visions of cosmic importance. The image, taken by Apollo 8 astronaut Bill Anders, was the famous photograph of the Earth rising above the arid, lifeless horizon of the Moon. It became an instant classic, one of the most important images of the 20th century and certainly among a handful of the most influential photographs in human history.

Perhaps it was our surprise that contributed to the power of the image. No one, certainly not the crew members nor the NASA planners back on Earth, had given much thought to what the home planet would look like from a lunar distance. All eyes were on the propulsion system of the Apollo Command and Service Module, on all the things that had to go right, on that one lone engine that had to work perfectly to put the astronauts into lunar orbit. It was only after that event, when they swung around the far side of the Moon, that the power of that image hit them, and later, all of us. The photo made the front page of newspapers and the covers of magazines. A few weeks after the flight, someone sent a telegram to Apollo 8 Commander Frank Borman that said simply, "You saved 1968."


For several years, Walter Cronkite's evening newscast used the "Earthrise" photo as a backdrop. The poet Archibald MacLeish was moved by the photograph and wrote, "To see the Earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the Earth together, brothers on that bright loveliness in the eternal cold—brothers who know now that they are truly brothers."

Stewart Brand published *The Whole Earth Catalog* with that picture on the cover. Others cred-

ited the photograph with inspiring the ecology movement and the first Earth Day in 1970. And today, 32 years later, TIME has published a coffee table book, "Great Images of the 20th Century." Of course, "Earthrise" is the cover photo. That one photograph came to symbolize not just the entirety of Project Apollo, but also stood for a whole decade, even a whole century.

We who are a part of NASA's air and space program sometimes take for granted the immense wealth of imagery that has been gathered in our 85-year history. Elsewhere in this issue, you will read about a commercial investment in the power of that archive, and of a venture NASA has embarked upon to digitize and distribute as widely as possible the wealth that lies within our vaults. It is an innovative agreement, forged by a highly talented team of NASA employees and a group of visionary investors from the private sector who could see the possibilities of combining the best of NASA's photographic holdings with the immediacy and accessibility of the Internet. Most of the work will be done with minimal investment of public funds, and NASA will retain its rights to the images and the ability to make them available in the public domain.

By digitizing large portions of the archive and providing cutting-edge, high-definition TV footage of the space program's activities, NASA and its new partner will take an important step toward preserving it for future generations. And instead of limiting the public's access to a small fraction of the collection, thousands of previously unseen images will become available over the Internet in the years ahead. This has been an objective of NASA's for years, but would not have been possible on this scale without private investment. As NASA Administrator Daniel Goldin said, "Our first dollar is for safety, and our second dollar is to make sure our spacecraft work properly. There often is not enough to do many of the other things we would like."

In time, the new views that come to us from our aeronautical research, studies of the Earth and from our spacecraft in this new century will find their way into a vast digital archive, available to all at the click of a mouse. And somewhere within that collection, you can be sure, future generations will find meaning, inspiration and the 21st century successor to the "Earthrise" of Apollo 8. 

COVER STORY

Live! On a Computer Near You

A RECENTLY ANNOUNCED PARTNERSHIP between NASA and Dreamtime Holdings, Inc., will propel the space information age to new heights.

The partnership will deliver the adventures of the space frontier through the new technologies of the digital frontier.

The unprecedented agreement was announced June 2, 2000 at NASA's Ames Research Center in Moffett Field, California. It includes provisions to provide, for the first time, high-definition television (HDTV) coverage of astronaut activities aboard the International Space Station and on Space Shuttle missions. It will also create an easily accessible, Web-searchable, digital archive of the best of NASA's space imagery.

Via the Web, users will be able to watch Neil Armstrong's first steps on the Moon, look at a blueprint of the lunar module and take a virtual reality tour of Armstrong's Apollo 11 capsule.

"Not only does this bring the space program into partnership with Silicon Valley," said NASA Administrator Daniel S. Goldin, "but the partnership also puts NASA at the forefront of the information age. This is innovative government at its best."

The NASA-Dreamtime partnership will provide unprecedented public access to space exploration by creating a state-of-the-art multimedia portal, www.Dreamtime.com. The portal will open the door to thousands of images, sounds, documents, plans and blueprints from NASA's currently underutilized archives. Rollout of the in-depth portal site will begin within the next several months.

The unparalleled space content will be accessible via Web, wireless, TV and interactive TV devices. Shuttle launches will light up handheld

computers and students will be able to watch compelling interactive space programming on TV and the Web. Users will be able to listen in on Mission Control, see the landscape of Mars in 3D from a future Mars lander and watch a Shuttle launch beamed right to a handheld device.

"Our goal of engaging more Americans in the exploration of space will be made possible through this partnership," Goldin said.

"We're proud to be partnered with NASA in this historic undertaking," said Bill Foster, Dreamtime's chairman and chief executive officer. "To us, space is the great adventure, and this is the perfect

marriage of high tech and high emotion. The opportunity to educate and excite is at the heart of this venture."

The NASA-Dreamtime partnership will also provide the agency with HDTV capability that will give NASA engineers and scientists the most detailed look ever at Shuttle flight operations and at scientific experiments conducted on the Shuttle and on

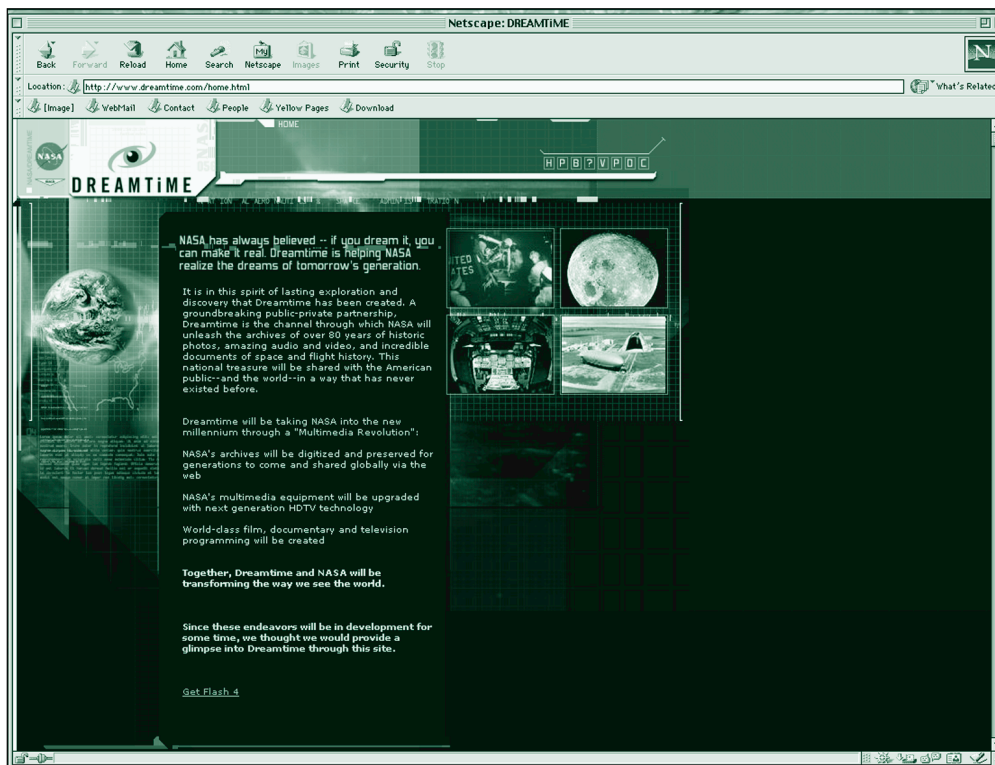
the International Space Station. In addition to other data collection methods, exact and precise digital images will further research capabilities.

Education plays a prominent role throughout the agreement. Educational content planned in the documentaries and TV broadcasts will be linked to educational modules in the portal.

"We plan to vividly convey the space experience into classrooms and living rooms across America," Foster said. "This partnership intends to explain the complexities of space in an interesting, entertaining and educational way."

The partnership's first priority will be to create the Dreamtime.com portal, which will offer the latest in interactive technology. The portal will be designed to provide more complete and in-depth access to information about space by combining video, audio, still photographs, high-resolution images, historical documents and three-dimensional views of spacecraft such as the Mars Sojourner and imagery from the Hubble Space

"TO US, SPACE IS THE GREAT ADVENTURE,
AND THIS IS THE PERFECT MARRIAGE
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OF THIS VENTURE."



A historic public-private partnership between NASA and Dreamtime Holdings, Inc. will allow the public to access a digital archive of NASA's space imagery via www.dreamtime.com.


Telescope. The portal's invigorating content will also include space topic bulletin boards, educational activities and games, chat rooms and e-cards.



Dreamtime's commercial partners in this venture include the Endeavor Agency, Excite@Home, Lockheed-Martin, Sumitomo Bank and Omnicom. Carleton Ruthling will serve as Dreamtime's president and chief operating officer. Nancy Conrad, widow of former Apollo astronaut Pete Conrad, is the first person to join Dreamtime's Board of Directors. Dreamtime headquarters will be in leased space located at NASA's Ames Research Center.

The U.S. Congress declared commercial utilization to be one of the primary goals of the U.S. Space Program when it passed the 1998 Commercial Space Act and directed NASA to actively seek commercial users for the International Space Station. Congress asked NASA to conduct an independent market study to help identify potential

commercial uses. One of the most promising commercial markets identified by the study was the utilization of space imagery in the areas of education and entertainment.

NASA publicly solicited offers for commercial collaboration in December 1999, stating its intent to partner with the private sector to create new market opportunities in the multimedia arena. Dreamtime was selected from 12 offers based on criteria published in the announcement. The term of the agreement between NASA and Dreamtime is for seven years with a five-year option.

The Dreamtime partnership maintains NASA's ability to offer the public its current level of services and does not preclude the agency from participating in other private sector partnerships. 

For more information, contact Brian Welch, NASA spokesperson
 202/358-1600  bwelch@mail.hq.nasa.gov Please mention you read about it in *Innovation*.

TECHNOLOGY TRANSFER

Glenn Hosts Microsystems Forum

INDUSTRY REPRESENTATIVES, BUSINESS LEADERS and researchers interested in exploring partnering opportunities in the rapidly evolving area of microsystems had a chance to discuss the exciting possibilities at the IDEAS Forum hosted by NASA Glenn Research Center, Cleveland, Ohio, in November 1999.

The forum was called IDEAS, highlighting innovations, demonstrations, exhibits, applications and spinoffs in microelectromechanical systems, or MEMS. Technologies showcased focused on health monitoring in harsh environments including sensors, actuators, microelectronics, packaging, micromachining and other supporting topical areas.

Sponsored by Glenn's Commercial Technology Office, the forum included poster displays of microsystem technologies, technology presentations, industry-focused sessions and a tour of Glenn sites, including microsystems laboratories and micromachining/packaging facilities.

In addition, keynote addresses were presented by Dr. Al Pisano and Dr. David E. Cole. Pisano is a professor in the Department of Electrical Engineering and Computer Sciences at the University of California at Berkeley and is affiliated with the Berkeley Sensor & Actuator Center. Cole, who is the director of the Office for the Study of Automotive Transportation at the


University of Michigan's Transportation Research Institute, works extensively on internal combustion engines, vehicle design and overall automotive industry trends.



Approximately 160 people attended the forum. Attendees included representatives from Glenn, NASA Marshall Space Flight Center, NASA Goddard Space Flight Center, Jet Propulsion Laboratory, Case Western Reserve University, the University of Cincinnati, Cleveland Clinic, DaimlerChrysler, Goodyear, Carnegie Mellon University, Picker International, Energizer/Eveready, Proctor & Gamble, the Ohio State University, Dow Chemical, Cleveland Tomor-



Glenn Research Center hosted the IDEAS Forum in November 1999. The forum provided an opportunity for industry representatives, business leaders and researchers to discuss microsystems. The IDEAS forum included technology presentations, poster displays of microsystem technologies and industry-focused sessions. (Photos provided by Glenn Research Center.)

row, Moog Inc., Accumed Systems Inc., Pratt & Whitney and others.

NASA Glenn is a partner in the Glennan Microsystems Initiative. The five-year program, which started in 1998, combines the expertise at Glenn and Case Western Reserve University, Cleveland, Ohio, with industry to advance the application of MEMS. A goal of the initiative is to identify and manufacture several prototype devices that will operate in harsh industrial, aerospace and biomedical environments. 

For more information, contact Laurel J. Stauber at Glenn Research Center
 216/433-2820  laurel.j.stauber@grc.nasa.gov Please mention you read about it in *Innovation*.

Lightning Strike Location System Developed

AVOID IN LIGHTNING DETECTION WILL SOON be filled, thanks to a product that uses technology developed at NASA Kennedy Space Center. The NASA-patented Accurate Location of Lightning Strikes technology was developed to determine the ground strike point of lightning in the immediate vicinity of the Space Shuttle launch pads.

Since electronic equipment is highly susceptible to lightning strike damage, the accurate knowledge of the striking point is important to determine which equipment or system needs to be re-tested following a strike. Accurate to within a few yards, this technology can locate a strike in the perimeter of the launch pad area.

The system was designed by Dr. Pedro Medelius, currently employed by Dynacs Inc., the NASA Kennedy Engineering Development Contractor. The prototype system consists of a network of one electric field antenna and three or more sonic sensors separated from each other by about 30 feet and located at different places within the perimeter of the observation area.

Consumer Lightning Products, Inc. (CLP) of Asheville, North Carolina is developing the project, called the Precision Lightning Strike Location System (PLSLS).

CLP believes this new technology will benefit many organizations, such as insurance and utility companies, airports, government agencies and golf courses, with more precise lightning strike information, including why lightning strikes a given location.



A lightning strike location system will benefit organizations by providing more precise lightning strike information, including why lightning strikes at given locations. (Photo provided by Kennedy Space Center.)

CLP President and inventor Sam Gasque believes that one of the major social benefits of the new PLSLS technology is verification of insurance claims. "Each year, claims due to lightning strikes continue to climb. Where insurance companies once would simply pay a claim, today they tend to verify the loss first, before settlement. Individuals may now need to prove there was a lightning strike in their area before they can recoup damages," Gasque explained.

"Insurance companies will call the Weather Service or similar service to find out if there was a thunderstorm in a claimant's area on the specific day of loss. If not, the claimant may have trouble getting paid for the damages," Gasque added.

As PLSLS is implemented in given areas, exact information regarding lightning strikes can be given to either the consumer or the insurance company. According to Gasque, once PLSLS is implemented further, sporting events will become safer, as well as air travel and traffic signals. Utilities will also become more reliable during storms. All of these improvements will have a positive impact economically.

"The bottom line of PLSLS is once you know exactly where lightning strikes, you can identify the attraction. After you remove or neutralize the attraction, the frequency of strikes is substantially minimized. Minimize the strikes and you create a safer social and industrial environment with minimal loss," Gasque stated.


CLP wants to know exactly where lightning strikes so it can determine what is attracting the lightning. "CLP's initial research was focused on airports and,

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specifically, airport runway lighting systems. Larger airports may have thousands of miles of cable underground. Airports that were formerly U.S. military air bases could have 10 times more wire and cable underground than needed. This old, abandoned cable could easily draw a lightning strike and provide a path for lightning to the other side of the facility, where it destroys all electronics in its path," Gasque said.

The PLSLS could show maintenance crews the location where lightning has hit. Crews could then correct the situation so that the attraction to lightning is minimized in the future.

CLP also developed the Lightning Retardant Cable (LRC) with the help of Kennedy and the Southern Technology Applications Center. This award-winning technology helps protect electrical wires and cables from strikes.

Plans call for CLP to initially offer the PLSLS technology with its LRC as a package for airports. From there, it will expand to power utilities, sports facilities, defense, industry and government. The product design will be adapted for commercial applications and enhanced operation. CLP plans to test the first prototypes in late fall of 2000. 

For more information, contact Thomas Gould at Kennedy Space Center
 321/867-6238  Thomas.Gould-1@ksc.nasa.gov Please mention you read about it in *Innovation*.

Technology Safely Strips Paint from Ships

A NEW ROBOTIC DEVICE, WHICH HAS RECEIVED kudos from environmentalist and undersea explorer Jean-Michel Cousteau, could revolutionize paint removal in the shipping industry.


The system, which safely strips paint from the hulls of ships without polluting the environment, is based on NASA robotics technology and was developed by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, the Robotics Engineering Consortium at Carnegie Mellon University in Pittsburgh, Pennsylvania, and UltraStrip Systems, Inc. of Stuart, Florida.



The new system consists of an automated robotic device that is magnetized to the ship, a set of high-pressure jet streams and a controller that helps the robot navigate along the surface of the ship. The water is filtered and then reused, while the paint residue is collected in a container to be disposed of safely. Using this method, no toxic dust or paint flakes are generated to pollute nearby areas or be inhaled by system operators. Previous stripping methods sandblasted paint from a ship's hull, producing large amounts of toxic airborne dust and exposing workers, nearby communities and the environment to significant

NASA TEAMS WITH NATIONAL CANCER INSTITUTE

To treat symptoms of the common cold, most people take a gel capsule containing hundreds of granular pieces of medicine as a remedy for coughing, sneezing and a runny nose. Now, imagine ingesting a capsule of similar size, containing microscopic sensors to detect, diagnose and treat disease inside the human body. It sounds like science fiction. However, NASA, in collaboration with the National Cancer Institute (NCI), is working to turn this vision into "science fact."

To mark the unique partnership, NASA Administrator Daniel Goldin and National Cancer Institute (NCI) Director Dr. Richard Klausner signed a memorandum of understanding to develop new biomedical technologies that can detect, diagnose and treat disease here on Earth and in space. The development of such technologies will improve life on Earth and one day revolutionize medicine and space travel.

The joint collaboration comes as NASA and NCI each move forward with historic initiatives requiring major advances in available technology. NCI is attempting to define cancer for the first time based on the unique molecular characteristics of tumors. NASA is seeking to develop a new form of patient care—"microscopic explorers"—that would travel through the human body, monitoring health conditions and detecting molecular signatures of disease when they appear. This technology will allow NASA to monitor astronaut health and treat conditions in space, where medical test capabilities and communication with Earth will be limited. 

For more information, contact Renee N. Juhans in the NASA Headquarters Office of Public Affairs  202/358-1712  rjuhans@hq.nasa.gov
Please mention you read about it in *Innovation*.



A new robotic device that safely strips paint from the hulls of ships without polluting the environment, is shown in action removing paint from a test wall. (Photo provided by Jet Propulsion Laboratory.)

risks. The new method, which uses UltraStrip's patented Robotic M2000 hydroblasting technology, uses only water in the paint-removal process and produces dried paint chips and clean water. Since a powerful vacuum collects all water and paint, nothing can escape to pollute the environment.

"Having now personally seen demonstrations of the M2000, I know the system works," said Cousteau, president of Ocean Futures of Santa Barbara, California. "It is inspiring to see a technology that can have such a positive environmental impact while at the same time providing a benefit to the profitability of the shipyard industry."

"Robotics technology developed at the various NASA centers has resulted in new products ranging from automated harvesting, coal mining, earth moving and material transport to robotic inspection and repair for gas pipelines, and agricultural spraying, to name a few," said Dr. Neville Marzwell, who heads Advanced Concepts and Technology Innovations at JPL.

"We feel that the UltraStrip application is an excellent match with our commercialization goals. This system gives us a great opportunity to showcase robotics technology in a significant commercial appli-

cation which will benefit the environment at the same time," said Bill Ross, consortium project manager.

Still in development are computer-vision-based "cruise control"; sensors to detect surface quality, paint thickness and any paint left on the hull; and diagnostic and analytic tools to optimize the speed of the robot for efficient and effective operations.

The technology was created under the National Robotics Engineering Consortium—a NASA, industry and university partnership to develop new industrial products and services from technologies that help solve key problems and reinvigorate the U.S. robotics industry. Consortium activities provide a process to move rapidly developing robotics technology into industrial applications, and, in turn, to provide next-generation technology products for the agency's science missions. The consortium also provides hands-on experience to students who will be the next generation of robotics scientists, technologists and engineers. ^f

For more information, please contact Dr. Neville I. Marzwell at Jet Propulsion Laboratory ✉ Neville.I.Marzwell@jpl.nasa.gov ☎ 818-354-6543. Please mention you read about it in *Innovation*.

ADVANCED TECHNOLOGIES

Satellites Helping to Predict Outbreaks

NASA IS PROVIDING NEW INSIGHTS FROM space that may help health officials predict outbreaks of deadly water-borne cholera, a bacterial infection of the small intestine that can be fatal to humans.

Scientists have learned how to use satellites to track blooms of tiny floating plant and animal plankton that carry cholera bacteria by using satellite data on ocean temperatures and other climate variables. The work is described in a recent paper, co-authored by the University of Maryland Biotechnology Institute (UMBI) and NASA researchers, that appeared in the Proceedings of the National Academy of Sciences.

"These experiments fulfill our hypothesis that cholera is associated with environmental conditions," said Dr. Rita Colwell, co-author of the cholera-tracking project paper. She is founder and former president of UMBI, and is now director of the National Science Foundation. She is presently on leave of absence from the University of Maryland.

The authors found that rising sea temperatures and ocean height near the coast of Bangladesh in the Bay of Bengal from 1992 to 1995 often preceded sudden growth, or "blooms," of plankton and outbreaks of cholera. Similar application of risk analysis developed by NASA using satellite data has also been used in the study of diseases such as malaria, Lyme disease and Rift Valley fever.

"When such a model for Bangladesh is extended to the global scale, it may serve as an early warning system, enabling effective deployment of resources to minimize or prevent cholera epidemics in cholera-endemic regions," said Brad Lobitz, principal author of the paper and a scientist at NASA's Ames Research Center in Moffett Field, California. The scientists correlated years of hospital cholera records from Bangladesh with sea temperature and ocean height data that came from a variety of satellites and surface observations.

Satellites can measure water temperature and ocean height, and can measure colors that indicate plankton and chlorophyll over a large sea area, Lobitz explained. Tracking sea temperatures from ships and by other direct measurements is too expensive to be practical, he added.

Cholera may result in extreme diarrhea, vomiting and loss of water. Victims can die within a day or so unless body fluids are replenished quickly. The seventh cholera pandemic began in 1961 and now affects six continents, according to the paper. A pandemic is an epidemic that occurs over a large region.


Sea height is important because tides reach further inland to affect more people who may drink or bathe in brackish water carrying cholera. "Bangladesh is very low and flat, and tidal effects are felt almost halfway up into the country," said co-author Louisa Beck of California State University at Monterey Bay and a resident scientist at Ames.

"The 1992-1995 study is important because all the remote sensing satellite data are in the public domain," Beck said "...we obtained the data at no cost because it is available on the web."

"In most years Bangladesh has two cholera outbreaks," Lobitz said. "These are in the spring and fall." The authors discovered that the sea surface temperatures show an annual cycle similar to the cholera-case data.

The effort was a cooperative project between NASA's Office of Life and Microgravity Sciences and Applications and UMBI. The study was also supported by grants from the National Institutes of Health and the Environmental Protection Agency. Other authors include Byron Wood, Ames; Anwar Huq, UMBI; and George Fuchs and A.S.G. Faruque, the International Centre for Diarrhoeal Disease Research, Bangladesh.

The researchers used data from three Earth-observing satellites in the study: a National Oceanographic and Atmospheric Administration weather satellite, the SeaWiFS instrument aboard the SeaStar (OrbView-2) satellite, and the U.S.-French TOPEX/Poseidon oceanography satellite. Data from SeaWiFS and TOPEX/Poseidon are provided through NASA's Office of Earth Science, which is dedicated to studying how natural and human-induced changes affect the Earth's global environment.

More information about the cholera-tracking project can be found on the Internet at: <http://geo.arc.nasa.gov/sge/health/projects/cholera/cholera.html> 

For more information, contact Brad Lobitz at Johnson Controls World Services, NASA Ames Research Center ☎ 650/604-3223 ✉ blobitz@mail.arc.nasa.gov
Please mention you read about it in *Innovation*.

Technology Finds Hidden Faults

NASA'S INVESTMENT IN AIRBORNE LIDAR (light detection and ranging) mapping technology is paying major dividends in an assessment of earthquake hazards in the Puget Lowland of Washington state.

Dr. David Harding, a geophysicist at NASA Goddard Space Flight Center in Greenbelt, Maryland, is working with local municipalities and the United States Geological Survey (USGS) to map earthquake hazards along the Seattle fault zone using commercial airborne LIDAR mapping capabilities. A commercial LIDAR mapping industry has emerged in the past few years, based in part on instrumentation and techniques first developed by NASA.

The results of a pilot LIDAR mapping effort and the status of current LIDAR activities in the Puget Lowland were presented by Dr. Harding during the American Society of Photogrammetry and Remote Sensing annual conference.

"LIDAR is the best technique we have right now to map the topography of the ground where it is covered by vegetation," says Harding. "The images reveal much more detail at the surface than previous methods. Until a LIDAR mapping survey was flown, no surface trace of faults in the Seattle fault zone had been identified, either on the ground or from remote sensing, due to the dense vegetation cover of the Pacific Northwest temperate rainforests."

Before LIDAR technology, aerial photographs were used to map surface features, but thick forest cover made locating the ground virtually impossible. Using LIDAR technology, scientists can filter out high measurements from leaves or branches above the surface to get a more accurate elevation map of the underlying ground.

Harding represents NASA in the Puget Lowland LIDAR Consortium that has contracted with Terrapoint,

LLC of Houston to map a large region of the Puget Lowland, including the entire extent of the Seattle fault zone. NASA Goddard Space Flight Center's Commercial Technology Office funded a cost-sharing project with the Houston Advanced Research Center (HARC) to enable the commercialization of the airborne laser mapping system. The system was developed by Bill Krabill, a researcher at NASA's Wallops Flight Facility, for the Arctic Ice Mapping program. Terrapoint, which employed the NASA-designed technology, is jointly owned by

HARC and TREIC Enterprises, Inc., a subsidiary of Transamerica Corporation. Funding for the Puget Lowland mapping is being provided by a congressional appropriation to Kitsap County through the USGS, NASA's Solid Earth and Natural Hazards program, the City of Seattle and the Puget Sound Regional Council.

The Consortium's efforts were inspired by LIDAR data from Bainbridge Island in Puget

Sound, collected in 1996 by the commercial company Airborne Laser Mapping for the Kitsap Public Utility District (KPUD). The LIDAR image collected under the direction of Greg Berghoff at the KPUD revealed a previously unrecognized fault scarp, an offset in the land surface formed by faulting, in the Seattle fault zone. In order to guide collection of additional Puget Lowland LIDAR data by the consortium, Harding and Berghoff evaluated the Bainbridge Island data to understand how it revealed the fault scarp.

Once a fault scarp is found, USGS scientists dig a trench across the scarp to examine the folded and faulted rock layers. A detailed study of these layers and dating of material from within the fault zone can reveal the number, size and age of the earthquake events that formed the scarp.

"Natural hazard assessment is only one application of this mapping technique," says Harding. "Assessing stream quality for salmon spawning, documenting forest cover conditions, evaluating land use and urban sprawl and floodplain mapping will also benefit greatly using LIDAR mapping technology." Harding reported that the data from the Puget Lowland also will be used to test observations from

A DETAILED STUDY OF FOLDED AND
FAULTED ROCK LAYERS AND DATING OF
MATERIAL FROM WITHIN THE FAULT ZONE
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FORMED THE SCARP.

ADVANCED TECHNOLOGIES

NASA's recently completed Shuttle Radar Topography Mission and from an upcoming LIDAR mission, the Ice, Cloud, and Land Elevation Satellite (ICESat). [f](#)

For more information, contact Dr. David J. Harding at Goddard Space Flight Center ☎ 301/614-6503 ✉ harding@denali.gsfc.nasa.gov Please mention you read about it in *Innovation*.

Laser Could Replace Dentist's Drill

Work to develop a high power laser for remote sensing of the atmosphere may lead to a laser that will replace both the dentist's drill and scalpel. (Photo provided by Langley Research Center.)

IN THE NEAR FUTURE, A LASER DEVICE inspired by NASA may replace the dentist's drill. Flip a switch and it will also replace the dentist's razor-sharp scalpel. Best of all, it's virtually painless and requires no anesthesia for most patients.

Lasers exist today that work on hard tissue to prepare teeth for filling, and on soft tissue for gum treatment and oral surgery.

Buying two laser systems is expensive. Only five percent of approximately 140,000 U.S. dentists use a laser system.

Now, researchers at NASA Langley Research Center, Hampton, Virginia, have demonstrated that the two laser wavelengths important to dentists can be produced from a single, easy-to-use system.

"The system is simple because we've already done all the complex physics in the lab," said Langley laser researcher Keith Murray, one of three inventors of the dental laser technology.

The other inventors are Norman Barnes, also of Langley's Laser Systems Branch, and Ralph Hutcherson of Scientific Materials Corp., Bozeman, Montana.

Both wavelengths can be produced using the same hardware, dramatically reducing cost and complexity. Dentists can switch between the two by selecting the amount and rate of energy pumped into the specially designed laser system. The resulting hardware, estimated to run about one-half the cost of two distinct laser systems, is about one-half the size of two systems and, unlike typical present-day

systems, does not require the laser system to be "tuned" by the operator.

Lantis Laser, Inc., Hewitt, New Jersey, is working with NASA Langley to refine the technology to explore its potential as a commercial dental laser product. Under the terms of a Space Act Agreement, a Lantis scientist will perform research in a Langley laboratory with help from the technology's inventors. Assuming Food and Drug Administration (FDA) approval of the technology by mid-2001, the goal is to begin sales of the device by the end of 2001.

Dr. Craig Gimbel is a dentist, a co-founder of Lantis and a principal investigator for the FDA clinical trials that led to



the May 1997 approval of lasers for hard tissue dentistry. Dr. Gimbel believes both patients and dentists would find much to like about a dual-wave dental laser.

"Filled teeth can be stronger," according to Dr. Gimbel, "because a laser removes less of the healthy tooth for filling. A dual wavelength laser could also minimize blood flow during surgery by searing the cut. And the dentist feels more comfortable when the patient feels more comfortable. When I don't have to use a dental drill, or I don't have to use a scalpel, or I don't have to use anesthesia in all procedures, I feel better and, of course, so does my patient," said Gimbel.

The discovery of the two wavelength technology is a spin-off of work to develop high power lasers for remote sensing of the atmosphere, a key element in NASA's atmospheric sciences mission. The technology has also been used in aeronautics research, including measurements of winds, wind shear and turbulence in-flight, and measurement of wake vortices from the ground in airport terminal areas. Those investigations led to the discovery that it is possible to selectively produce two or more useful wavelengths from a single laser source. [f](#)

For more information, contact Barry Price at Langley Research Center
☎ 757/864-7146 ✉ b.l.price@larc.nasa.gov Please mention you read about it in *Innovation*.

ELECTRONIC NOSE IS NOTHING TO SNEEZE AT

NASA scientists are expanding the sensitivity of an electronic nose, while shrinking its size to make it more compact for future space missions, following a Space Shuttle flight that successfully demonstrated the technology.

"The E-Nose was able to determine changes in humidity accurately, which we confirmed using an independent humidity monitor in the shuttle cabin," said Dr. Amy Ryan, principal investigator for the E-Nose at NASA's Jet Propulsion Laboratory, Pasadena, California.

Although the E-Nose was able to determine changes in humidity accurately, none of the 10 contaminants the E-Nose was designed to monitor was present. Results of contaminant monitoring were confirmed using air samples brought back from the flight.

The ability to monitor recycled air is very important to the space program, especially in environments such as the Space Shuttle, the International Space Station and any future space outpost that features a closed human habitat. Early detection of potentially harmful spills or leaks is essential so crew members can immediately take action to remedy the situation. Even if a human nose could detect every possible odor and identify it, fatigue or a cold would impair the nose's sensing ability.

"Space crews are very, very busy," said Ryan. "Anything we can do to automate their tasks and keep the space habitat safe is highly desirable. Now we need to further develop E-Nose's capability to detect various odors and differentiate between those that signify danger and those that do not. We are working with people at other NASA centers to optimize this technology."

Since there are limits on size and power requirements in constricted quarters, miniaturization is important. The unit flown on STS-95 is only about the size of a large paperback, weighs 1.4 kilograms (about three pounds) including the operating computer, and uses an average of 1.5 watts of power.

"Our current efforts are directed towards improving the sensitivity of the E-Nose, expanding the compounds we can detect from 12 to 24 and making the unit even smaller," Ryan said.

A major application that JPL scientists are pursuing is the detection of a fire before the blaze erupts. Fires can smolder in closed areas, such as insulation in paneling or around wires, for some time before flames actually appear. With early detection, the fire can be extinguished safely before much damage occurs.

Potential commercial uses include "sniffing" for unexploded land mines, spills in chemical plants that could contaminate workers, plant ripeness to harvest at the desired point in the agricultural cycle and possible diagnosis of disease, based on odors from human perspiration and breath.

The JPL E-Nose flown on the Space Shuttle used sensor technology from the California Institute of Technology in Pasadena. The project is managed for NASA's Office of Life and Microgravity Sciences and Applications. [f](#)



The electronic nose (lower right) is pictured with samples of some of the contaminants it is designed to monitor. (Photo provided by Jet Propulsion Laboratory.)

For more information, contact Dr. Darrell L. Jan at Jet Propulsion Laboratory ☎ 818/354-4542 ✉ darrell.l.jan@jpl.nasa.gov Please mention you read about it in *Innovation*.

AEROSPACE TECHNOLOGY DEVELOPMENT

San Francisco Airport Goes Virtual

A SYNTHETIC AIRPORT, CREATED IN THE computer mind of a two-story NASA simulator, will help San Francisco airport, one of the country's largest and most complex, plan changes to increase its efficiency.

The San Francisco International Airport (SFO) Commission has selected NASA's FutureFlight Central, the world's only walk-in, full-scale, 360-degree airport simulator, to evaluate new tower positions, runway configuration and aircraft movements before new construction begins.

"NASA's FutureFlight Central hopes to save airports costly design errors by permitting them to easily experience different, highly realistic versions of their airport design and, most importantly, observe how real people work inside these future environments," said Dr. Paul Kutler, deputy director of the NASA Ames Information Systems Directorate.

The virtual simulator is located at Ames Research Center, Moffett Field, California. The facility can

house as many as a dozen air traffic controllers, and it can represent the busiest U.S. airport towers in size and capability.

"NASA's FutureFlight Central allows SFO to preview potential tower locations before any concrete is poured," said Peg Devine, deputy airport director for SFO's Air Field Development Bureau. "This is part of SFO's continuing commitment to deploy the appropriate technology advances to address our rising air passenger levels as well as decrease delays."

Airport officials say they chose the NASA simulator to help plan airport changes to increase both efficiency and total air traffic capacity. Using the one-of-a-kind airport testing facility, SFO airfield planners, Federal Aviation Administration air traffic controllers and others will help to select the best location for a new tower.

"Engineers can identify future problems and can try solutions in a safe setting, the computer's virtual world," said Nancy Dorigi, who manages the facility at Ames.

The simulator's artificial world changes in real time. Scenes evolve in the same manner that real-world changes occur. In the computer world, airplanes not only come and go, but weather changes.

NASA's FutureFlight Central is allowing officials from San Francisco International Airport to experiment with different locations for a new air traffic control tower.



Consoles are at each controller's location showing radar, weather maps, runway lights and touch-screen controls, as well as other readouts.

"We are able to represent any airfield in existence or as planned for the future," said Dorigi. "We can measure the impact of a change on the airport's capacity, and let the controllers try it first-hand, all before anything is built."

After putting a new airport data set into the computers, FutureFlight researchers can switch to the new artificial airport in moments. Rearranging furniture in the simulator will take longer than activating a new computerized airport, NASA technicians noted.

Other unique features of NASA FutureFlight Central include: the capability to move the tower "eye point" to any location, including a "pilot eye view;" precise controls to simulate weather, time-of-day, cloud coverage and lighting; a voice and data communication network, allowing ground-to-tower and air-to-tower human interaction; and video record and playback, allowing analysis of human performance and decisions. f

More information about FutureFlight Central is available on the Internet at: <http://ffc.arc.nasa.gov>

Technology Could Cut Mars Travel Time

AN AGREEMENT TO COLLABORATE ON DEVELOPMENT of an advanced rocket technology that could cut in half the time required to reach Mars, opening the solar system to human exploration in the next decade, has been signed by NASA Johnson Space Center, Houston, Texas, and MSE Technology Applications Inc., Butte, Montana.

The technology could reduce astronauts' total exposure to space radiation and lessen time spent in weightlessness, perhaps minimizing bone and muscle mass loss and circulatory changes.

Called the Variable Specific Impulse Magneto-plasma Rocket (VASIMR), the technology has been under development at Johnson's Advanced Space Propulsion Laboratory. The laboratory is under the direction of Franklin Chang-Diaz, a NASA astronaut who holds a doctorate in applied plasma physics and fusion technology.

Chang-Diaz, who began working on the plasma rocket in 1979, said, "A precursor to fusion rockets, the VASIMR provides a power-rich, fast-propulsion architecture."

Plasma, sometimes called the fourth state of matter, is an ionized gas made up of atoms stripped of some of their electrons. Stars are made of plasma, which is gas heated to temperatures of millions of degrees. No known material could withstand temperatures of these magnitudes. Fortunately,

plasma is a good electrical conductor, which allows it to be held, guided and accelerated by properly designed magnetic fields.

The VASIMR engine consists of three linked magnetic cells. The forward cell handles the main injection of propellant gas and its ionization. The central cell acts as an amplifier to further heat the plasma. The aft cell is a magnetic nozzle that converts the energy of the fluid into directed flow.

Neutral gas, typically hydrogen, is injected at the forward cell and ionized. The resulting plasma is electromagnetically energized in the central cell by ion cyclotron resonance heating. In this process, radio waves give their energy to the plasma, heating it in a manner similar to the way a microwave oven works.

After heating, the plasma is magnetically exhausted at the aft cell to provide modulated thrust. The aft cell is a magnetic nozzle, which converts the energy of the plasma into velocity of the jet exhaust, while protecting any nearby structure and ensuring efficient plasma detachment from the magnetic field.

A key to the technology is the capability to modulate the plasma exhaust to maintain optimal propulsion efficiency. This feature is like an automobile's transmission, which uses the power of the engine

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AEROSPACE TECHNOLOGY DEVELOPMENT

either for speed when driving on a level highway or for torque over hilly terrain.



On a mission to Mars, such a rocket would continuously accelerate through the first half of its voyage, then reverse its attitude and slow down during the second half. The flight could take slightly over three months. A conventional chemical mission would take seven to eight months and involve long periods of unpowered drift en route.

There are also potential applications for the technology in the commercial sector. A variable-exhaust plasma rocket would provide an important operational flexibility in the positioning of satellites in Earth orbit.

Several new technologies are being developed for the concept, Chang-Diaz said. They include magnets that are superconducting at space temperatures, compact power generation equipment and compact and robust radio frequency systems for plasma generation and heating.

Coordinated by NASA Johnson's Office of Technology Transfer and Commercialization, the Space Act Agreement calls for a joint collaborative effort to develop advanced propulsion technologies, with no money exchanged between the two parties. Such

agreements are part of NASA's continuing effort to transfer benefits of public research and development to the private sector. 

For more information, contact John Ira Petty  281/483-2530
 john.i.petty1@jsc.nasa.gov Please mention you read about it in *Innovation*.

New Aircraft Technologies Selected for Research

NASA'S OFFICE OF AEROSPACE TECHNOLOGY (OAT) has selected nine aeronautical concepts for awards as part of its Revolutionary Concepts (REVCON) program, which accelerates the exploration of high-risk, revolutionary breakthrough technologies in atmospheric flight.

NASA Dryden Flight Research Center, Edwards, California, is the lead center for the REVCON program, with significant involvement from NASA Ames Research Center, Moffett Field, California; Glenn Research Center, Cleveland, Ohio; and Langley Research Center, Hampton, Virginia.

NASA PARTNERS IN NEW CLASSROOMS


Students in Brooklyn, New York, and Los Angeles, California, can now explore the world of science and technology using the latest computer hardware and software.

The Major Owens Aeronautics Education Laboratory (AEL), named for Brooklyn Congressman Major R. Owens, opened in May on the campus of Medgar Evers College. Los Angeles Southwest College serves as the site for the Los Angeles AEL, which opened in mid-June.

The laboratory moves beyond traditional classroom boundaries and offers a state-of-the-art, electronically enhanced, computerized environment that puts cutting-edge technology into the hands of students in grades 7 to 12. At various workstations, students will strengthen math and science skills as they examine elements of satellite global positioning, remote sensing, amateur radio and aircraft design.

"Math and science skills are essential to our nation's future prosperity. Our students deserve every opportunity to develop the skills they need to be successful. This facility will give students the chance to explore the fascinating world of aeronautics and learn of the endless opportunities education can provide," said NASA Administrator Daniel Goldin at the opening of the Los Angeles AEL. Goldin was also a participant in opening ceremonies at the Brooklyn site.

NASA's Office of Equal Opportunity Programs, Washington, DC, provided a \$200,000 grant for the partnership to establish the laboratory. NASA Glenn Research Center at Lewis Field, Cleveland, Ohio, is responsible for the design and implementation of the AEL.

A vision of former Ohio Congressman Louis Stokes, the program was established in 1993 by Glenn Research Center and Cuyahoga Community College, Cleveland, Ohio, to help foster understanding and enthusiasm in school-age children for science, math and technology fields. Since its inception, the Science, Engineering, Mathematics, and Aerospace Academy and its laboratories have grown from a single location to a multiple-site organization. 

The nine winning projects are described below.


- Advanced Supersonic Propulsion and Integration Research aims to validate a two-dimensional, mixed-compression engine inlet for commercial applications. Glenn will lead this project with partners Dryden; Lockheed Martin Skunk Works, Palmdale, California; United Technologies Research Center, East Hartford, Connecticut; General Electric Aircraft Engines, Cincinnati, Ohio; Techland Research, North Olmsted, Ohio; Gulfstream Aerospace, Cleveland, Ohio; and the Air Force Research Laboratory, Dayton, Ohio.
- APEX is a highly instrumented, remotely piloted glider air-launched at an altitude of 100,000 feet by a balloon. It will obtain data to validate design and analysis methods for high altitude and high-subsonic speeds. Dryden leads a team that includes Ames, Langley and Glenn.
- Joined-Wing Integrated Structures Flight Demonstration is a revolutionary airborne surveillance concept consisting of a joined-wing aircraft with radar apertures integrated into the four joined wings. Langley is the lead with partners from Dryden; The Boeing Company, Phantom Works Division, Seattle, Washington; Naval Air Systems Command, Patuxent River, Maryland; and the Air Force Research Laboratory.
- The Reliable Autonomous Control Technology project will develop an autonomous management system for uninhabited aircraft to achieve reliability equivalent to current piloted aircraft. Dryden is the team lead, with partners Lockheed Martin Tactical Aircraft Systems, Fort Worth, Texas; Lockheed Martin Skunk Works and NASA's Jet Propulsion Laboratory, Pasadena, California.
- Revolutionary Propulsion for Aeronautical Vehicles is the combined effort of the lead General Electric Aircraft Engines, and partners General Electric Corporate Research and Development, Schenectady, New York; Lockheed Martin Tactical Aircraft Systems; Advanced Projects Research, Inc., La Verne, California; the Air Force Research Laboratory; Glenn and Dryden. This team will

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TECHNOLOGIES IN ATMOSPHERIC FLIGHT.

design and develop a pulse-detonation technology to integrate with an existing engine and provide increased thrust and fuel efficiency.

- The Shape Memory Alloy Variable Area Fan Nozzle project will address the development of smart-material actuation for a variable-area fan nozzle. United Technologies Research Center will lead the project with support from partners Pratt & Whitney, East Hartford, Connecticut; Northrop-Grumman, Los Angeles, California; Dryden; Glenn and Langley.
- Smart Vehicle—Advanced Technology Demonstrator consists of an uninhabited technology demonstrator that will showcase innovative, hingeless aerodynamic effectors that will increase the maneuverability and performance of the vehicle with reduced signature. This project will be led by Langley with partners Lockheed Martin Tactical Aircraft Systems; Physical Sciences, Inc., Andover, Maine; Tel Aviv University, Israel; Naval Air Systems Command and Dryden.
- Swashplateless Flight will be demonstrated by a team made up of Advanced Technologies, Inc., Newport News, Virginia; Diversified Technologies, Inc., Bedford, Massachusetts; Ames; Dryden and Langley. They will integrate an on-the-blade, electromechanical servo-actuator into a civil helicopter and demonstrate primary flight control without using a mechanical swashplate.
- The goal of the Variable Diameter Tilt Rotor flight experiment is to advance the technology readiness of a concept that optimizes the rotor configuration for both hover and cruise flight. This project joins Sikorsky Aircraft Corporation, Stratford, Connecticut, as the lead with Dryden, Ames and Langley.

More information about REVCON can be found on the Internet at: <http://www.dfrc.nasa.gov/Projects/revcon/index.html> 

For more information, contact Michael Braukus at NASA Headquarters  202/358-1979  mbraukus@hq.nasa.gov Please mention you read about it in *Innovation*.

SMALL BUSINESS/SBIR

NASA Develops Drill for the Future

IT'S AN INVENTION THAT MAY EVENTUALLY end up in the hands of every craftsperson and orthopedic surgeon.

Scientists at NASA's Jet Propulsion Laboratory, Pasadena, California, together with engineers from Cybersonics, Inc., Erie, Pennsylvania, have developed an ultrasonic device that can drill and core very hard rocks and also has medical applications.

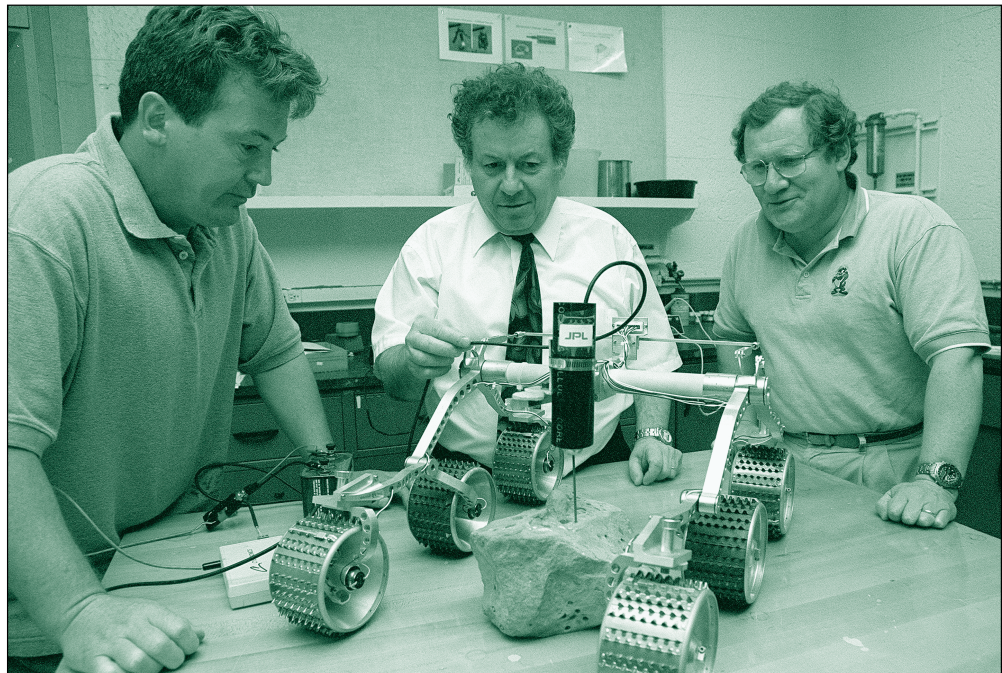
Potential medical uses include extracting pace-maker leads and the drilling necessary during surgical or diagnostic procedures involving the human skeletal structure. Future space missions could include drilling for samples using lightweight landers with robotic arms and small rovers that roam the surface of an asteroid or planet.

"The drill is an ultrasonic device that offers exciting new capabilities for space exploration in future

NASA missions," said Dr. Yoseph Bar-Cohen, who leads JPL's Nondestructive Evaluation and Advanced Actuator Technologies unit. "Besides the immediate benefits of the technology to NASA, it is paving the way for other unique ultrasonic mechanisms that are being developed in our laboratory and elsewhere. Such devices can be made to be small and lightweight, to consume little power and to exhibit a high standard of reliability."

"This technology can be miniaturized to fit in the palm of a hand," said Tom Peterson, president of Cybersonics, Inc. Cybersonics holds a patent for the Ultrasonic/Sonic Drill and Corer. "There are numerous commercial applications, especially in the medical field. We are very pleased with the progress in development and look forward to finding even more useful applications."

The drill is driven by piezoelectric actuators, which have only two moving parts but no gears or motors. Piezoelectrics are materials that change their shape under the application of an electrical field. The drill can be adapted easily to operations



The ultrasonic driller/corer is shown operating from a small rover. Pictured, from left, are Dr. Stewart Sheritt, CalTech postdoctoral scholar; Dr. Yoseph Bar-Cohen, who leads JPL's Nondestructive Evaluation and Advanced Actuator Technologies unit; and Dr. Benjamin Dolgin, task manager for robotic drilling at JPL. (Photo provided by Jet Propulsion Laboratory.)




The drill/corer developed at JPL is shown drilling into sandstone while being held from its power cord. Relatively little vertical force is used in this application—a factor that will be useful when the drill is used in future space missions to drill and core for samples during planetary and asteroid explorations. (Photo provided by Jet Propulsion Laboratory.)



in a range of temperatures from extremely cold to very hot. Unlike conventional rotary drills, the drill can core even the hardest rocks, such as granite and basalt, without significant weight on the drilling bit.

The current demonstration unit weighs roughly 1.5 pounds (0.7 kilograms), which is sufficient to drill half-inch (12-millimeter) holes in granite using less than 10 watts of power. Comparable rotary drills usually require the application of 20 to 30 times greater pushing force and more than three times the power. The drill/coring bit does not require sharpening and its drilling speed does not decrease with time. There is no drill chatter, no drill walk on start-up and the drill does not rotate. The bit can be guided by hand safely during operation. The drill can core holes in different cross-sections, such as square, round or hexagonal.

The technology was initially developed under a NASA Small Business Innovation Research (SBIR) Phase I contract that funded Cybersonics, Inc., and

later received funding from the NASA TeleRobotic Intercenter Working Group. Currently, the development is funded by the NASA Exploration Program (Mars and Deep Space), and the Cybersonics effort is funded by an SBIR Phase II contract.

Further information about the ultrasonic drill and other nondestructive evaluation and advanced actuator technologies is available on the Internet at <http://ndaaa.jpl.nasa.gov> 

For more information, contact Dr. Yoseph Bar-Cohen at Jet Propulsion Laboratory  818/354-2610  Yoseph.bar-cohen@jpl.nasa.gov Please mention you read about it in *Innovation*.

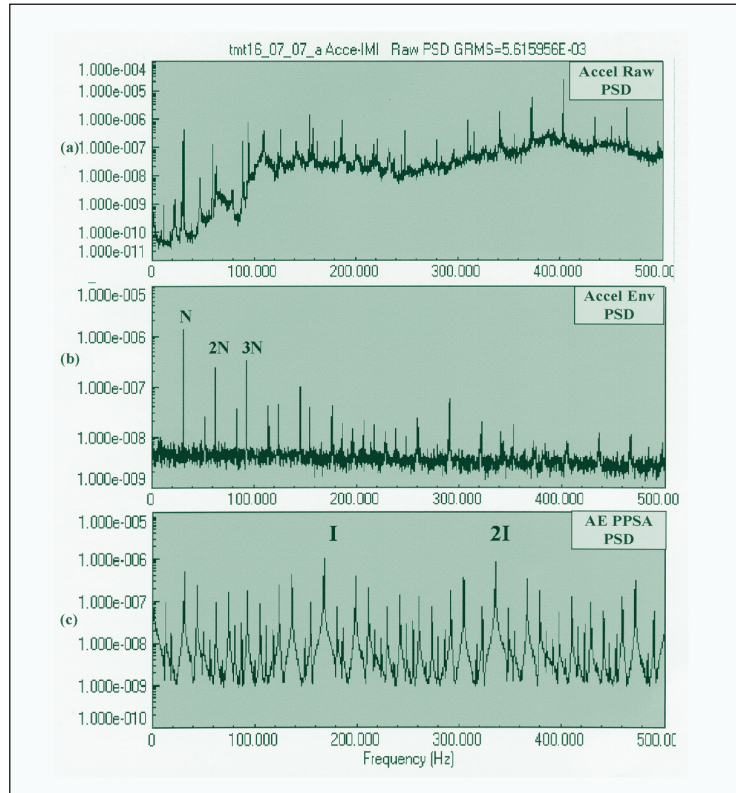
Acoustic Emission Diagnostics Improved

ACOUSTIC EMISSIONS HAVE BEEN USED TO detect crack development for more than 20 years, but a Huntsville, Alabama-based company has put a new spin on the process. Traditional methods entail listening for acoustic emissions, or “hits,” for possible crack initiation and crack growth. However, the Acoustic Emission Bearing Fault Diagnostics System (AEBDS) developed by AI Signal Research focuses on the periodicity of these hits.

In a Small Business Technology Transfer (STTR) effort with NASA Marshall Space Flight Center in Huntsville and Georgia Tech University in Atlanta, Georgia, AI Signal is employing high-frequency sensors to monitor periodic hit rates and patterns for incipient fault detection of rolling element bearings. With the AEBDS, such competing noises as rotor dynamics, hydrodynamics and engine combustion are taken out of the equation, enabling a much cleaner signature. Innovative signal processing techniques with real-time results run an order of magnitude less in computational intensity.

As part of Phase II of the STTR effort, AI Signal performed AEBDS laboratory testing using a Bridgeport vertical mill as a bearing test rig. Bearing signatures for both good bearings and bearings with known seeded faults were tested. The vast majority of ball bearing defects tested fell into one of three categories: inner race defect, outer race defect, and ball defect. Digitizing conditioned analog electrical outputs of four instrumentation transducers produced the raw data for testing. Each 100-second test pro-

SMALL BUSINESS/SBIR




Bearing test data with seeded light (4-mill-wide) inner race defect: (a) Raw PSD of accelerometer output; (b) Envelope PSD of the accelerometer; (c) PPSA PSD of an acoustic emission transducer. (Photo provided by Marshall Space Flight Center.)

duced a 0.667GB data file that was post-processed using PC-SIGNAL™ software.


PC-SIGNAL general purpose vibration analysis software, also developed by AI Signal, is tightly integrated into the AEBDS system. A compilation of signal processing code that runs totally autonomous on personal computers, PC-SIGNAL is slated for release later this year. Because much of the software incorporated into PC-SIGNAL was developed in SBIR efforts to support the Space Shuttle main engine and other propulsion programs, the software possesses advanced capabilities to diagnose very subtle information. After all, bearing failure in a high-speed turbopump could have potentially catastrophic consequences.

PC-SIGNAL has already been used by NASA engineers to analyze high-frequency data for the Fastrac engine and the X-33. For the U.S. Army Redstone Technical Test Center, the easy-to-use software design has significantly reduced the analysis time for large volumes of test data.

The AEBDS has proven its effectiveness in detecting incipient bearing degradation. As a safeguard

against costly plant downtime, the AEBDS has commercial applications for the aircraft/helicopter, transportation and nuclear power industries, as well as for rocket engine manufacturers. PC-SIGNAL has applications for all types of machinery. 

For more information, contact Dr. Jen-Yi Jong at AI Signal  256/551-0008

 jong@aisignal.com Please mention you read about it in *Innovation*.

Ultracapacitor Helps Company Grow

SPECIALIZING IN THE DESIGN, DEVELOPMENT and commercialization of advanced, cutting-edge materials to the nanometer scale (10⁻⁹ m), T/J Technologies, Inc. may help redefine the world of portable electronics.


Founded on a shoestring budget in 1991 by the husband and wife team of Levi and Maria Thompson, the company now generates more than \$2 million in revenues and has won a list of awards underscoring their achievements. The company has contracts with NASA Marshall Space Flight Center, the U.S. Air Force, the U.S. Army, the Department of Defense, the Ballistic Missile Defense Organization and the National Science Foundation.


T/J Technologies designs, develops and manufactures advanced materials and devices for electrochemical energy storage and conversion. Presently the company's main focus is on rechargeable batteries, ultracapacitors and fuel cells. The materials and associated processes offer significant advantages in applications where power, size and cost are at a premium. Other programs use related materials in catalytic, structural and gas sensing applications.

A cross between batteries and regular capacitors, ultracapacitors answer the need for lightweight, more efficient power sources. Ultracapacitors can be used to extend battery life or enable the use of smaller and lighter battery systems. Electrodes developed by T/J Technologies for use in ultracapacitors can be made from widely available, relatively inexpensive materials. This type of technology has been targeted for use where intermittent, high-power energy pulses are required, such as regenerative braking systems, traffic signaling and cellular communications. Other commercial applications include computer memory backup, cordless

power tools, portable electronics, electric/hybrid vehicles, industrial lasers and automotive subsystems.

In a Phase III Small Business Innovation Research (SBIR) effort with NASA Marshall, T/J Technologies is developing high surface area transition metal nitrides and carbides for use in ultracapacitors. Because of their high conductivity and open microstructures, these electrodes can be used to produce ultracapacitors with lower resistances and higher power densities than devices based on commercially available carbon elec-

trodes. According to the Marshall Phase III contract technical representative, David K. Hall of the Electrical Power Subsystems Team, "This is an enabling technology for pulse power applications such as electromechanical actuators and burst digital communications," that can result in lighter weight energy sources with better power quality and lifecycle performance. 

For more information, contact Maria Thompson, T/J Technologies President,  734/213-1637 Please mention you read about it in *Innovation*.


SBIR IS "TURNING GOALS INTO REALITY"

SBIR program managers led a workshop session in the Turning Goals Into Reality (TGIR) conference, sponsored by NASA's Aerospace Technology Enterprise and held in May at NASA Marshall Space Flight Center, Huntsville, Alabama.

During the workshop, SBIR program managers shared information with participants about ways to access NASA technology and mechanisms for partnering with NASA. SBIR and the program offices themselves must continue to explore innovative ways of developing and commercializing NASA technologies if the aggressive goals and objectives outlined by the enterprise are to be met. The SBIR program works with the NASA enterprises to target new opportunities in research areas where innovation in small businesses can potentially make a difference.

The SBIR program showcased in a poster some of the technologies developed over the past few years, through SBIR, for the Advanced General Aviation Transport Experiments (AGATE) consortium. AGATE, an industry-university-government cost-sharing partnership, was initiated by NASA in 1994 to create the technological basis for revitalizing the U.S. general aviation industry. Its goal was to develop affordable new technology as well as industry standards and certification methods for airframe, cockpit, flight training systems, and airspace infrastructure for next generation single pilot, 4-6 place, near all-weather light airplanes. The AGATE consortium has more than 70 members from industry, universities, the Federal Aviation Administration (FAA) and other government agencies.

The TGIR conference served to report across a spectrum of research areas on the recent accomplishments by the Aerospace Technology Enterprise and its industry partners. Through presentations and panel discussions on the state of aerospace transportation research, technology exhibits, and workshops on future program directions, including the topic of breakthrough technologies, the conference participants were able to interact with NASA managers in lively discussions on the future of aerospace. Conference speakers included NASA Administrator Daniel Goldin; Samuel Venneri, NASA's Associate Administrator for the Office of Aerospace Technology; Vern Raburn, president and CEO of Eclipse Aviation, Inc.; and Thomas McKendree from the Foresight Institute.

Approximately 400 members of the aerospace community attended the conference. The third TGIR conference is scheduled for late spring 2001 and will be hosted by Ames Research Center, Moffett Field, California. To find out more about TGIR visit: <http://www.aerospace.nasa.gov/curevent/2000/may.html> 

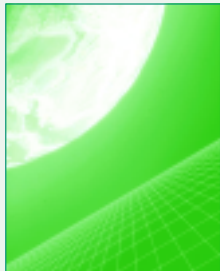


More than 400 aviation and aerospace industry professionals gathered for the opening sessions of NASA's second "Turning Goals into Reality" conference, hosted by Marshall Space Flight Center. (Photo provided by Marshall Space Flight Center.)

For more information, contact Jenny Kishiyama at NASA Headquarters  202/358-4649,  jkishiyama@hq.nasa.gov Please mention you read about it in *Innovation*.

TECHNOLOGY OPPORTUNITY SHOWCASE

Moving Forward



Technology Opportunity Showcase highlights some unique technologies that NASA has developed and that we believe have strong potential for commercial application. While the descriptions provided here are brief, they should provide enough information to communicate the potential applications of the technology. For more detailed information, contact the person listed. Please mention that you read about it in *Innovation*.

Miniature Broadband Light Source

NASA Glenn Research Center, the Jet Propulsion Laboratory and Lighting Innovations Institute are seeking potential users and developers of a miniature broadband microelectromechanical systems (MEMS) light source. This optical source is expected to provide up to 250 mw of optical power over a 500- to 900-nm wavelength region. This MEMS light source has a planar geometry that can be easily integrated with fiber optics and silicon-based drive electronics. It requires less electrical input power than most commercial light sources and is small, rugged and lightweight. Those characteristics are attractive for aeronautic and space applications. Other benefits of the device include its increased reliability, reduced heat generation and stable spectral output. Potential commercial uses include use as an aeropropulsion light source for optical sensors, as a calibration source for spectrometers, as a light source for space sensors and lighting, as display lighting and as a component for an addressable array. Industries where this product can be applied include aeronautics, space, military vehicles and automobiles. [f](#)

For more information, contact Margaret L. Tuma, Ph.D., at Glenn Research Center ☎ 216/433-8665 ✉ margaret.l.tuma@grc.nasa.gov Please mention you read about it in *Innovation*.

Revolutionary Low-Cost Joints

NASA Marshall Space Flight Center is seeking companies to license and/or jointly develop innovative technologies that combine the benefits of, and improve upon, bolted and welded joints. These low-cost technologies use a thermal element to seal, bond, braze and/or weld static joints. Joints fabricated with these technologies can be permanently assembled with minimal process variability, may be disassembled for service, and do not degrade over time. The technologies are based on a thermally or electrically conductive substrate that is positioned in a joint under preload. The substrate may be coated with adhesives, thermoplastics, epoxies or braze alloys that melt when heated by the conductive substrate to complete the joint.

Primary benefits of the technology include low cost, improved process control, easy disassembly, no fumes and reduced surface finish requirements. Additional benefits include thinner joints for

reduced relaxation problems, ease of use, fast melting and curing, and low ignition risk. These technologies can be used in a wide variety of static sealing applications for bolted, bonded, brazed and welded joints. Potential commercial applications include hazardous fluid and other industrial piping joints, marine engine and transmission housing joints, automotive cooling system housing joints and sealed electrical housings. [f](#)

For more information, contact Benita C. Hayes at Marshall Space Flight Center ☎ 256/544-9276 ✉ Benita.C.Hayes@msfc.nasa.gov Please mention you read about it in *Innovation*.

Microresonant Igniters

The Combustion Branch of the NASA Glenn Research Center, Cleveland, Ohio, is interested in partnering opportunities for the development of microcombustion systems. Formal partnering arrangements would be made through NASA Space Act agreements.

Microresonant igniters are considered to be reliable, inexpensive and could be part of a lightweight ignition system requiring multiple ignition sources. They have no moving parts and require no electrical excitation. Therefore, they would be especially appropriate in systems where electromagnetic interference (EMI) is an issue. Microresonant igniters could also be considered for a micropropulsion device ignition system. Their use is restricted to relatively low molecular weight working fluids (i.e., hydrogen or methane). In a resonant ignition system, the flow from a sonic orifice is directed into a tube. The flow creates a pattern of strong acoustic waves in the tube, which results in a significant temperature rise in the working fluid. If the heat loss from the tube is minimized, this temperature rise is sufficient to initiate combustion for some propellant combinations.

The goal of current research is to demonstrate ignition in a device with a footprint measuring approximately one square centimeter. The device's geometry can be reproduced photolithographically. Both computational and experimental approaches are being pursued to optimize the resonator geometry. [f](#)

For more information, contact Kevin Breisacher at Glenn Research Center ☎ 216/977-7475 ✉ Kevin.J.Breisacher@grc.nasa.gov Please mention you read about it in *Innovation*.

NCTN DIRECTORY Moving Forward



NASA Field Centers

Ames Research Center

Selected technological strengths are Information Technologies, Aerospace Systems, Autonomous Systems for Space Flight, Computational Fluid Dynamics and Aviation Operations.

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Dryden Flight Research Center

Selected technological strengths are Aerodynamics, Aeronautics Flight Testing, Aeropropulsion, Flight Systems, Thermal Testing and Integrated Systems Test and Validation.

Jenny Baer-Riedhart

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Glenn Research Center

Selected technological strengths are Aeropropulsion, Communications, Energy Technology and High Temperature Materials Research, Microgravity Science and Technology and Instrumentation Control Systems.

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Goddard Space Flight Center

Selected technological strengths are Earth and Planetary Science Missions, LIDAR, Cryogenic Systems, Tracking, Telemetry, Command, Optics and Sensors/Detectors.

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Jet Propulsion Laboratory

Selected technological strengths are Deep and Near Space Mission Engineering and Operations, Microspacecraft, Space Communications, Remote and In-Situ Sensing, Microdevices, Robotics, and Autonomous Systems.

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Johnson Space Center

Selected technological strengths are Life Sciences/Biomedical, Spacecraft Systems, Information Systems, Robotic and Human Space Flight Operations.

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Kennedy Space Center

Selected technological strengths are Emissions and Contamination Monitoring, Sensors, Corrosion Protection and Biosciences.

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Langley Research Center

Selected technological strengths are Aerodynamics, Flight Systems, Materials, Structures, Sensors, Measurements and Information Sciences.

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Marshall Space Flight Center

Selected technological strengths are Materials, Manufacturing, Non-destructive Evaluation, Biotechnology, Space Propulsion, Controls and Dynamics, Structures and Microgravity Processing.

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Stennis Space Center

Selected technological strengths are Propulsion Systems, Test/ Monitoring, Remote Sensing and Nonintrusive Instrumentation.

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NASA's Business Facilitators

NASA has established several organizations whose objectives are to establish joint sponsored research agreements and incubate small start-up companies with significant business promise.

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NASA-Sponsored Commercial Technology Organizations

These organizations were established to provide rapid access to NASA and other federal R&D agencies and foster collaboration between public and private sector organizations. They also can direct you to the appropriate point of contact within the Federal Laboratory Consortium. To reach the RTTC nearest you, call 800/642-2872.

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NASA ONLINE

Go to the **NASA Commercial Technology Network (NCTN)** on the World Wide Web at <http://nctn.hq.nasa.gov> to search NASA technology resources, find commercialization opportunities and learn about NASA's national network of programs, organizations and services dedicated to technology transfer and commercialization.

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